

REMARKS

Claims 1-14 are pending in the above-identified application. Claims 1-14 were rejected. With this Amendment, claims 1-5 and 7-14 were amended and claims 15-19 were added. Accordingly, claims 1-19 are at issue.

I. 35 U.S.C. § 112 (First Paragraph) Rejection of Claims 3-4 and 7-8

Claims 3-4 and 7-8 were rejected under 35 U.S.C. § 112, first paragraph, as purportedly containing subject matter not described in the specification. Applicant respectfully traverses this rejection.

The Examiner argued that “[t]he specification never discloses a surface of said first buried wiring is exposed to said dummy hole and the dummy hole is formed below said first buried wiring and has a diameter smaller than said contact hole as claimed in claim 3.”

Applicant respectfully disagrees. With respect to claim 3 and referring to Figures 7A-11 as an illustrative example, Applicant teaches a second buried wiring (216) formed over a first buried wiring (207). Applicant further teaches that the first buried wiring (207) has a lower surface exposed to the dummy hole (203) where the dummy hole (203) is formed below the first buried wiring (207). In addition, Applicant teaches that the dummy hole (203) has a diameter smaller than the contact hole (210). *See* Application, at pg. 27 line 9-pg. 29 line 22; pg. 33 lines 5-20; Figures 7A-11.

Accordingly, Applicant submits that the specification clearly supports the limitations recited in claim 3 and respectfully request that this rejection to claim 3 be withdrawn.

The Examiner also argued that “[t]he specification never discloses a surface of said first buried wiring is exposed to said dummy hole and the dummy hole is formed below said first buried wiring and has a diameter smaller than said contact hole as claimed in claim 4.”

Applicant respectfully disagrees. With respect to claim 4 and referring to Figures 13A-17 as an illustrative example, Applicant teaches a second buried wiring (305) formed under a first buried wiring (316). Applicant further teaches that the first buried wiring (316) has a lower surface exposed to the dummy hole (309) where the dummy hole (309) is formed below the first buried wiring (316). In addition, Applicant teaches that the dummy hole (309) has a diameter smaller than the contact hole (308). *See* Application, at pg. 41 lines 4-14; Figures 13A-17.

Accordingly, Applicant submits that the specification clearly supports the limitations recited in claim 4 and respectfully request that this rejection to claim 4 be withdrawn.

Claim 7 depends from claim 3 and claim 8 depends from claim 4. The Examiner did not identify any limitation of either claims 7 or 8 that was not supported by the specification. Accordingly, Applicant respectfully requests that this rejection to claims 7 and 8 also be withdrawn for the same reasons as provided for claims 3 and 4.

II. 35 U.S.C. § 112 (Second Paragraph) Rejection of Claims 1-13

Claims 1-13 were rejected under 35 U.S.C. § 112, second paragraph, as being indefinite. In particular, the Examiner stated that the term “a wiring material” lacked clear antecedent basis in claims 1, 6-13. Applicant has amended the claims to correct this informality.

The Examiner also argued that the limitation “said second buried wiring is formed as an upper layer of said first buried wiring” in claims 2, 3, 5, and 10 is unclear and suggested that the

limitation be replaced with “said second buried wiring is formed over said first buried wiring.” Similarly, the Examiner also argued that the limitation “said second buried wiring is formed as a lower layer of said first buried wiring” in claims 4 and 12 is unclear and suggested that the limitation be replaced with “said second buried wiring is formed under said first buried wiring.”

Although Applicant disagrees that these two limitations are unclear, to further prosecution Applicant has amended these claims to incorporate the Examiner’s suggested language clarifications.

With respect to claims 1, 5, 7-9, and 11-13, the Examiner stated that the limitation “said dummy hole ...is filled with said wiring material” is unclear as the “dummy hole would not cause a plugging failure when the dummy hole is filled with the wiring material.”

Although Applicant disagrees that the limitations in 1, 5, 7-9, and 11-13 are unclear, to further prosecution Applicant has amended these claims to remove the unclear language or add clarifying language consistent with the specification.

Accordingly, Applicant indefiniteness rejections to claims 1-13 has been overcome and respectfully requests that these rejections be withdrawn.

III. 35 U.S.C. § 102 Anticipation Rejection of Claims 1, 6 and 14

Claims 1, 6 and 14 were rejected under 35 U.S.C. § 102(b) as being anticipated by *Yang et al.* 6,468,894. Applicant respectfully traverses this rejection.

With respect to claim 1 as amended and referring to Figures 5-6, 10A-12, 16A-18 as illustrative examples, Applicant claims a semiconductor device that has the following limitations:

a first buried wiring (105, 207, 316);

a second buried wiring (115, 216, 305) formed as a layer different from said first buried wiring (105, 207, 316);

a contact hole (108, 210, 308) formed between said first buried wiring (105, 207, 316) and said second buried wiring (115, 216, 305) and filled with a wiring material electrically connecting said first buried wiring and said second buried wiring therethrough; and

a dummy hole (109, 203, 309) formed to have a hole diameter substantially different from that of said contact hole (108, 210, 308) and in the vicinity of said contact hole (108, 210, 308) so that a surface of said first buried wiring (105, 207, 316) is exposed to said dummy hole (105, 207, 316), wherein said dummy hole is adapted to cause a void (117, 206, 315) to form in association with said dummy hole (105, 207, 316) when said dummy hole is at least partially filled with said wiring material.

In addition, Applicant teaches that the problem of voids appearing in contacts (e.g., Copper vias) between buried wires as a result of stress migration (e.g., wiring and contacts subject to high temperature use for extended duration) may be solved by intentionally constructing a dummy hole extending to the first of the buried wires within proximity of the contact hole and having a substantially different diameter than the contact hole such that stress migration is released by causing a void to appear or grow first (if at all) in or below the dummy hole rather than in the contact hole. See Application, at pg. 6 line 9 - pg. 8 line 1; pg. 26 line 1 - pg. 27 line 6; pg. 33 line 5 - pg. 34 line 21; pg. 41 line 15 - pg. 42 line 21.

For example, with respect to the embodiment illustrated in Figures 5-6, Applicant teaches (and claims in at least claims 2 and 10) that the dummy hole can be formed to have a diameter substantially larger than the contact hole connecting a first and a second buried wiring when the dummy hole is formed in the vicinity of the contact hole over and in connection with the first buried wiring. Applicant further teaches that when the dummy hole has a larger diameter than the contact hole, the etching rate of the dummy hole is greater relative to the concurrent etching rate of the contact hole such that the dummy hole is inevitably formed more deeply and has more etching damage than the contact hole. As a result, copper filed at the bottom of the dummy hole has weaker adhesion to the underlying first buried wiring than the copper filing the contact hole such that subsequent stress migration of the first buried wiring and the contact hole is released by causing a void to first appear or grow in the dummy hole or below the dummy hole in the first buried layer rather than in the contact hole. *See* Application, at pg. 20 line 24 - pg. 22 line 8; pg. 25 line 3 - pg. 26 line 21; Figs. 2B-5.

Alternatively, with respect to the embodiments illustrated in Figures 10A-12, and 16A-18, Applicant teaches (and claims at least in claims 3-9 and 11-13) that the dummy hole can be formed to have a diameter substantially smaller than the contact hole connecting a first and a second buried wiring when the dummy hole is formed in the vicinity of the contact hole so that a surface of the first buried wiring is exposed to the dummy hole. By forming the dummy hole to have a smaller diameter than the contact hole, Applicant further teaches that the dummy hole may be formed to intentionally cause the dummy hole to have or generate a void (i.e., due to an intentional plugging failure) such that subsequent stress migration of the first buried layer is released through the void in the dummy hole, preventing a void from forming in the contact hole.

See Application, at pg. 27 line 18 - pg. 28 line 15; pg. 30 lines 10-16; pg. 33 line 5 - pg. 34 line 21; pg. 41 line 15 - pg. 42 line 21; Figs. 7B-11 & Fig. 14B-17.

In contrast, *Yang* discloses a metal interconnection structure with dummy vias 32, 34, 36, and 72 formed throughout the same dielectric material layer 18 or 58 to perform “only a mechanical strengthening function that helps to prevent delamination [of the vias from the dielectric material layer 18 or 58] and scratching during chemical mechanical polishing.” See *Yang*, Col. 4 lines 42-47; Col. 5 lines 31-54; Col. 6 lines 34-46; Figs 7 and 12. Thus, *Yang* fails to disclose the claim 1 limitation of “*a dummy hole formed to have a hole diameter substantially different from that of said contact hole and in the vicinity of said contact hole so that a surface of said first buried wiring is exposed to said dummy hole, wherein said dummy hole is adapted to cause a void to form in association with said dummy hole when said dummy hole is at least partially filled with said wiring material.*”

The Examiner argues that the dummy via 72 in Fig. 12 of *Yang* is larger in diameter than the contact hole occupied by via 70 and, thus, *Yang* teaches the claim 1 limitation of the “*dummy hole formed to have a hole diameter... different from that of said contact hole.*”

Applicant respectfully disagrees. The initial Examiner in this case acknowledged that *Yang* failed to teach this claim 1 limitation. In addition, Applicant submits that the difference in diameter of contact via 70 and the dummy hole 72 in Fig. 12 of *Yang* is not visibly perceptible. Furthermore, there is no discussion anywhere in *Yang* to support that the contact via 70 and the dummy hole 72 have different diameters. To further clarify Applicant’s invention, claim 1 has been amended to recite that the “dummy hole [is] formed to have a hole diameter [that is] substantially different from [the] contact hole” and not an insignificant difference. Assuming

arguendo that dummy hole 72 has a slightly larger diameter than contact via 70, *Yang* still fails to disclose the additional claim 1 limitation that the “*dummy hole is adapted [based in part on its diameter difference with the contact hole and connection to the first buried wiring] to cause a void to form in association with said dummy hole when said dummy hole is at least partially filled with said wiring material.*” Moreover, if the conductive line 64 is identified as a first buried wiring as suggested by the Examiner, the dummy via 72 would not be adapted to form a void because it is formed under the conductive line 64 and over a dielectric layer 56 so no void would ever be formed (due to etching of the dummy hole 72) between the conductive line 64 and the dummy via 72. To intentionally form a void in a dummy hole 72 requires the dummy hole to have a diameter smaller than the contact hole as taught and claimed by the Applicant in at least claims 3-5.

Accordingly, *Yang* (neither alone nor in combination with any prior art cited by the Examiner) fails to teach or suggest all the claim 1 limitations. Accordingly, Applicant respectfully requests that the rejection to claim 1 be withdrawn.

Claims 6 depends from claim 1 and should be deemed allowable for at least the same reasons as claim 1.

Claim 14 is directed to a semiconductor device having limitations similar to claim 1 as discussed above. As discussed above, *Yang* fails to disclose or suggest the limitation of “*a dummy hole formed to have a hole diameter substantially different from that of said contact hole and in the vicinity of said contact hole so that a surface of said first buried wiring is exposed to said dummy hole....*”

In addition, Applicant submits that *Yang* fails to disclose or suggest the claim 14 limitation that, with a substantially larger diameter than the proximate contact hole and exposed to the first buried wiring, *"the dummy hole [is] at least partially filled with [the] wiring material therein such that the dummy hole is operatively configured to inhibit a void from being generated in said contact hole when said first buried wiring is under stress."*

The Examiner argues that *Yang* inherently teaches this limitation because the dummy via 72 is operatively configured to inhibit a void from being generated in the contact via 70 when the first buried wiring or conductive layer 64 (connecting the dummy via 72 and the contact via 70) is under stress because the purportedly larger dummy via 72 absorbs all the stress from the conductive layer 64.

Applicant respectfully disagrees. As discussed above, if the conductive line 64 is identified as a first buried wiring as suggested by the Examiner, the dummy via 72 would not be adapted to form a void in association with the first buried wiring because the dummy via 72 as shown in Fig. 12 of *Yang* is formed under the conductive line 64 and over a dielectric layer 56 so no void would ever be formed (due to etching of the dummy hole 72) between the conductive line 64 and the dummy via 72.

Accordingly, Applicant submits that *Yang* fails to disclose or suggest all the limitations of claim 14 and respectfully request that the rejection to claim 14 be withdrawn.

IV. New Claims 15-19

Applicant has also added new dependant claims 15-19 to further distinguish Applicant's invention and respectfully requests consideration of these claims.

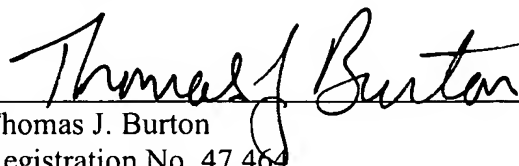
V. Conclusion

In view of the above amendments and remarks, Applicant submits that all claims are clearly allowable over the cited prior art, and respectfully requests early and favorable notification to that effect.

Respectfully submitted,

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By: _____

A handwritten signature in cursive script, appearing to read "Thomas J. Burton", is written over a horizontal line.

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